VOL. XII **TEXTILE RESEARCH** NO. 11

Outstanding Features in

This Month's Issue

Flexural Fatigue

If fabrics are folded to a degree that causes fiber strains exceeding the elastic limit of the fibers, permanent creasing results. Depending on the yarn and fabric constructions, folding may result in breakage of fibers and yarns. (See page 2.)

Bleaching of Cellulose

This is a report of studies on the underlying causes of damage due to bleaching processes. (See page 10.)

Mixed Fabric Analysis

A series of fabrics, comprised of wool with other fibers, were analysed by each of four methods. (See page 13.)

Warmth of Fabrics

A report of tests on fabrics comprised of varying percentages of wool made with a view of disclosing the value of wool from standpoint of warmth. (See page 18.)

Postwar Full Employment

This is a review of a program by Alvin H. Hansen for insuring continued prosperity after the war, eliminating both inflation and depression through proper economic control. (See page 24.)

Some Factors Affecting Life of Fabrics Are Explained by Research on

Flexural Fatigue

By HERBERT F. SCHIEFER AND PAUL M. BOYLAND

ABILITY OF A FABRIC to withstand repeated folding depends not only on the properties of the fibers, but also on the structure of the yarn and the construction of the fabric. Also it is shown that if textile materials are folded to a degree that causes fiber strains exceeding the elastic limit of the fibers, permanent creasing results.

These factors affecting the useful life of textiles are indicated by some experiments carried out at the U. S. Bureau of Standards in which different fabrics were put through a series of tests. Sample specimens taken from each fabric were tested for breaking strength and elongation, and others were flexed in an M.I.T. folding tester under a tension of 1.5 kg. The specimens were folded through an arc of 135 degrees, alternately toward one face and then toward the other at the rate of 200 double folds per minute. After a certain predetermined number of folds, the specimens were tested for breaking strength and elongation and the percentage decreases based upon the original breaking strength and elongation were computed.

Some of the flexed specimens were photographed before they were tested for strength in order to show the position of the failures of the fibers and of the yarns in relation to the fabric structure. For this purpose the specimen was folded through 180 degrees and placed between two microscope glass slides with the edge of the folded specimen coinciding with the line of folding in the

Fig. 1. Test specimens showing that the failure of fibers caused by flexural fatigue occur in alternate yarns. A, Fortisan, warp, 10,000 double folds; C, Fortisan, filling, 5,000 double folds. Magnification × 14.

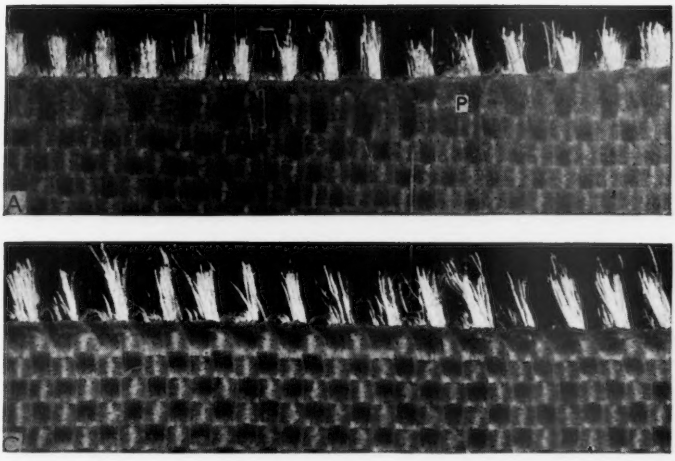
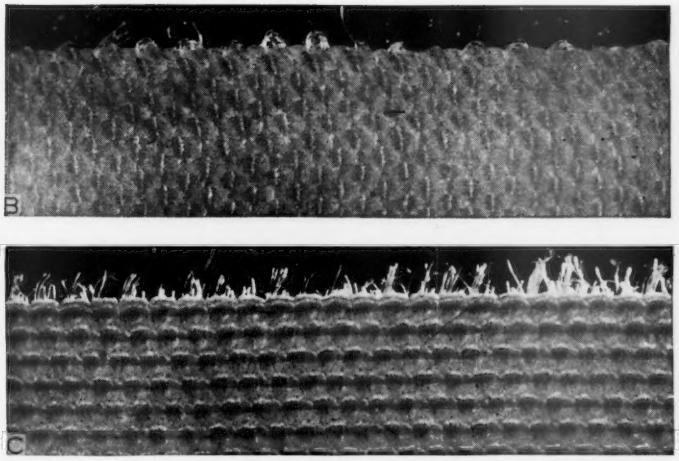
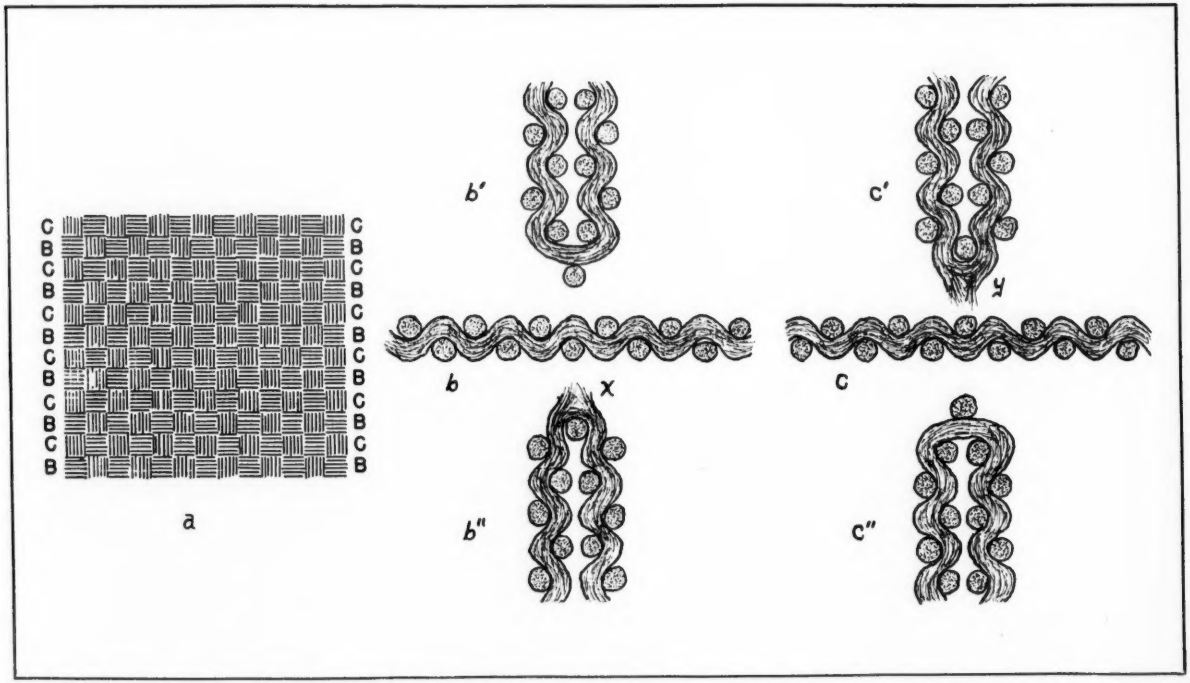


Fig. 2. Test specimens showing that the failures of fibers caused by flexural fatigue occur in alternate yarns. B, viscose rayon, filling, 10,000 double folds; C, acetate rayon, warp, 1,500 double folds. Magnification × 14.




C B C B C B

flexing test.

Repeatedly flexed specimens are shown in Figs. 1 and 2. It is clear that the fibers which have failed occur in alternate yarns. Fig. 3 is a schematic drawing of a plain woven fabric and gives sectional views showing the position of alternate yarns during a flexural-fatigue test. From a study of the drawing it will be seen that the failures of fibers in alternate yarns are due to fabric structure.

In Fig. 3-*a*, is a top view of the fabric. Sectional views through *BB* and *CC*, respectively are represented by *b* and *c*; *b'*, and *c'* represent these same sections when the fabric is folded upon itself, *B* to *B* and *C* to *C* with the upper surface inside; *b''* and *c''* represent the sections when the lower surface is inside. It can be seen from these figures that the radius of curvature of the yarns designated *B* is very much larger in *b'* than in *b''* and the opposite is true for yarns *C*.

Strains Increase with Curvature of Fold

The bending stress due to folding a given yarn will increase with the increase in the curvature of the fold. Therefore, the maximum stress of the *B* yarns is obtained when the fabric is folded as in *b''*, and the maximum stress of the *C* yarns is obtained when the fabric is folded as in *c'*. If the foldings are repeated, as in flexural-fatigue tests, it is apparent that the *B* yarns will begin to rupture at *x*, and the *C* yarns at *y*. The *x* failures will occur in alternate yarns on one side of the fabric, and the *y* failures will occur in alternate yarns on the other side.

Specimen A of Fig. 1 which was inserted in the folding tester at a slight angle, is of special interest. It shows that the failure of the warp yarns change from one set of alternate yarns to the other set at position marked *P*. This position corresponds to the place where the bending of the warp yarns over one filling yarn changes to bending over an adjacent filling yarn.

The percentage decrease in breaking strength and in

Fig. 3. Schematic drawing of a plain woven fabric and sectional views showing position of alternate yarns during a flexural fatigue test.

elongation due to folding is given in the accompanying table. It is seen to depend on the number of folds and upon the kind of fiber. The large percentage decrease for fabrics made of acetate rayon, Fortisan, and silk compared to no decrease for the fabrics made from viscose rayon, nylon and cotton is outstanding. This difference cannot be attributed to a change of weave or fabric structure. It is more likely that structural differences of the yarns and of the fibers in a yarn account for this large difference.

Effect of Coatings

That restriction of movement of fibers and of yarns in a fabric should decrease the folding endurance is indicated by the tests on samples of rubber and neoprene coated Fortisan fabrics. (See table.) The particular neoprene coating greatly increased the stiffness of the fabric, and hence restricted the movement of the fibers and yarns during folding much more than the rubber coating.

Similarly, differences in the freedom of movement of the structural units within fibers, which may result from chemical or mechanical treatment of the fibers, would affect the folding endurance of the fibers and also of the yarns and fabrics made from them.

As the freedom of movement of the fibers in a yarn relative to each other is restricted, the yarn approaches the properties of a homogeneous beam and the extreme fiber strains for bending to a radius R increases from the value r_1/R, where r_1 is the radius of the fiber, to r_2/R, where r_2 is the radius of the yarn.

Textile materials are frequently folded to a degree for which the computed value of r/R the extreme fiber strain, exceeds 0.25. For this value of r/R, which corresponds to an elongation of 25 per cent, the elastic limit of some textile fibers is exceeded and permanent deformation or creasing results.

TABLE I. Decrease in the Breaking Strength and Elongation of Fabrics by Repeated Folding.

Material	Number of Double Folds	Decrease in—	
		Breaking Strength	Elongation
		Percent	*Percent*
Rayon, acetate	1,000	13	31
	1,500	38	55
	1,700	56	59
	2,000	100	100
Fortisan:			
Warp	1,000	25	14
	5,000	58	43
	8,000	63	57
	10,000	68	57
Filling	1,000	0	0
	10,000	35	30
Silk:			
Warp	5,000	27	46
	10,000	46	54
Filling	5,000	27	36
	10,000	55	64
Rayon, viscose	10,000	0	0
Nylon:			
Warp	10,000	0	0
Filling	10,000	0	0
Cotton:			
Warp	10,000	0	0
	50,000	0	0
Filling	10,000	0	0
Fortisan:			
Warp	2,000	47	[a]
	10,000	70	[a]
Filling	2,000	25	[a]
	10,000	54	[a]
Fortisan, rubber-coated:			
Warp	2,000	45	[a]
	10,000	72	[a]
Filling	2,000	38	[a]
	10,000	71	[a]
Fortisan, neoprene-coated:			
Warp	2,000	85	[a]
	3,000	100	[a]
Filling	2,000	50	[a]
	5,000	62	[a]

[a] Elongation was not measured.

This paper also appears in *Journal of Research*, July 1942, p. 69–71.

RESEARCH ACTIVITIES

Mr. Donald Nelson has appointed a special committee of the War Production Board to survey the needs of American industry for research on war problems. It is assumed that this committee will study not only the important problems requiring immediate solution on various types of products used in the war program, but will attempt to budget the further needs not already being covered by existing research. This committee is headed by Maury Maverick, Chief of the Bureau of Governmental Requirements of the Division of Industry Operations, who has been active in promoting the need of a full mobilization of scientific research to meet the war needs. The other members of the committee are Dr. C. S. Gragg and A. C. C. Hill, Jr. It is expected that an office of Technical Development will be set up under the auspices of the War Production Board to supplement the work of the Office of Scientific Research and Development, and the National Inventors Council.

Dr. F. J. Lynch, director, Southern Research Laboratory, U. S. Department of Agriculture, recently emphasized the need for three lines of research on cotton lint: on the chemical and physical properties of the individual fibers; on the mechanical processing of cotton and its manufacture into various products; and on chemical finishes for cotton products.

Apropos of standard Launder-Ometer tests on textiles for color fastness to washing it has been discovered that in the case of certain applications of colors by printing, the former test methods have not been sufficiently severe. Samples of such printed fabrics

would pass these tests but after repeated commercial launderings the colors would prove unsatisfactory from a commercial viewpoint. A new method has been tried out which indicates that something along this line of furnishing more abrasive action should be adopted as a standard. This method consists of sewing the sample to be tested into a small bag into which are put a number of ¼ inch diameter steel balls and then running the launder-ometer test with an equal number of balls loose in the launder-ometer. The beating action then duplicates to some extent the abrasive action encountered in actual laundering practice.

The Textile Research Institute is engaged in assisting in some important studies in the field of aviation clothing for high altitude flying. This work is being conducted under the guidance of Dr. L. H. Newburgh, Chairman of the Subcommittee on Clothing of the Committee on Aviation Medicine. The latter committee was set up under the auspices of the National Research Council under the chairmanship of Dr. Eugene F. Du Bois.

The research and technical staff of National Association of Hosiery Manufacturers are now located at the general offices of the Association, 468 Fourth Ave., New York. For the past twenty years the Association has maintained a technical staff as an associateship at the National Bureau of Standards in Washington. However, owing to space demands for war activities of the Bureau this move was decided upon. E. M. Schenke who has headed the staff from the beginning will continue to direct the activities.

Research in Oxidation May Lead to Better Control of Damage by

Bleaching of Cellulose

POTENTIAL SCARCITY of textile materials in the present emergency makes it more important than ever that adequate means be taken to prolong their usefulness. The useful life of a textile material is greatly affected by the necessary treatments to which the fiber is subjected during manufacture.

Since some of these treatments tend to reduce the strength of the material, it is obviously desirable to keep this loss at a minimum. For example, it is well known that unbleached cotton goods have an undesirable yellowish tint. When such goods are treated with mild oxidizing agents, such as dilute solutions of sodium hypochlorite or hydrogen peroxide, the yellow color is removed. Although care is taken to avoid damage to the goods during this operation, there may occur some loss in strength.

In order to obtain adequate control in preventing this type of damage it is necessary to have a thorough knowledge of the conditions which produce it. Accordingly, the Research Associates for the Textile Foundation at the National Bureau of Standards have begun an investigation of the way cellulose is attacked by oxiding agents.

The first reaction studied was that of cotton cellulose with periodic acid. Periodic acid is not used in bleacheries for processing cotton, but the known selective action of this reagent made it desirable as a first subject of study in order to form a background for the proper understanding of the action of the common bleaching agents.

It was found that in some instances, the action of this oxidizing agent does not result in a direct loss in

strength but rather a latent type of damage is produced. Such damage is not indicated by usual strength tests until the bleached product is laundered or otherwise subjected to alkaline solutions. It appears that in such instances the action of the oxidizing agent reduces the chemical stability of the cellulose molecule of the cotton, but does not appreciably impair the original strength of the material. However, the effect on the chemically unstable groups of further treatment with alkalies results in far-reaching alterations in the molecular structure, thereby producing the subsequent loss in strength.

Reaction with Periodic Acid

Cellulose can undergo many modifications in oxidizing media and accordingly the properties of oxidized celluloses, generally referred to as oxycelluloses, vary widely. It appears that the attack on cellulose by oxidizing agents is principally confined to three points namely, (1) the aldehyde end-groups, of which there are few, if any, in native cellulose and which can be oxidized to carboxyl groups; (2) the primary alcohol groups which can be oxidized to the aldehyde or carboxyl stage; (3) the glycol groups which can be oxidized to the ketone, aldehyde or carboxyl stage. In this study there was found by experiment to be a measurable adsorption by the fiber of a portion of the oxidant. This needs to be taken into consideration in obtaining a measure of the periodic acid utilized in the oxidation of the cellulose.

New methods that have recently been developed enabled a study to be made of the course of the oxidation under treatment by periodic acid and the results are given.

The relationship between aldehyde content and alkali sensitivity was also studied and discussed.

(The detailed report prepared by Henry A. Rutherford, Francis W. Minor, Albert R. Martin, and Milton Harris, appears in the August, 1942, issue of *Journal of Research* under the title, "Oxidation of Cellulose. The Reaction of Cellulose with Periodic Acid.")

Important Contributions to Research in Textiles Have Been Made by

Milton Harris

Among the varied activities of Milton Harris, Ph.D., his contributions to knowledge of the molecular structure of textile fibers are especially outstanding.

Dr. Harris was graduated from Oregon State University in 1926, and in 1929 received his degree of Ph.D. in chemistry from Yale University.

After a year spent in the fur and leather industry and 2 years as research chemist with Cheney Bros., silk mills, he became research associate for the American Association of Textile Chemists and Colorists at the U. S. Bureau of Standards in Washington. In 1938 he was appointed director of research for the Textile Foundation and in 1941 was also made director of research for the Textile Research Institute.

Milton Harris, director of research for Textile Foundation and Textile Research Institute

Bureau of Home Economics Study Compares Four Methods for

Mixed Fabric Analysis

Increasing use of fiber mixtures in the construction of fabrics is emphasizing the importance of accurate methods for the quantitative determination of the component parts, particularly the wool content, of such mixed fabrics.

In order to determine the relative accuracy of the principal methods now being recommended for testing the wool content of fabrics, as well as to indicate the advantages and disadvantages of each method, a study was undertaken at the Bureau of Home Economics, U. S. Department of Agriculture.

The results of this study are given in a report by Lillian E. Weidenhammer, Junior Chemist at the Bureau, which appears in American Dyestuff Reporter, *September, 1942, under the title "A Comparative Study of Four Methods for the Quantitative Determination of Wool in Mixed Fabrics." The following is an abstract of the original report.*

In the sulphuric acid and the aluminum chloride methods the cellulosic fiber is removed chemically, leaving the wool. In the caustic boil method, widely used by industry because it is quick and convenient, the wool is dissolved and cotton or rayon remains. In this last-named method the cellulosic material dissolves to some extent also in the caustic solution, which necessitates the use of a correction factor in calculating the percentage of cotton or rayon. The American Society for Testing Materials recognizes the sulphuric acid and the aluminum chloride methods as

tentative standards and are now including the caustic boil method in the D–13 manual.

In all chemical methods one component of the mixture is destroyed, leaving the other as residue. It is possible to separate wool from either cotton or viscose rayon by a flotation method which makes use of the difference in the specific gravity of the fibers. Both components are recovered. A.S.T.M. has given some attention to this method also.

In the Bureau of Home Economics study all tests were made by the same operator and an analysis was made of several mixed fabrics by all four of these methods. These fabrics were as follows: A and B were made from blends of cotton and wool combed together. Fabric A contained approximately 80 per cent of wool, and fabric B approximately 20 per cent of wool.

Fabrics C and D were manufactured under the direction of the Bureau of Home Economics from known new wool and spun viscose rayon. Yarns were spun from carefully weighed wool and rayon and woven into these

Fig. 1. Effect illustrated of boil-out by two methods. Left—cotton removed by sulphuric acid. Right—wool removed by caustic.

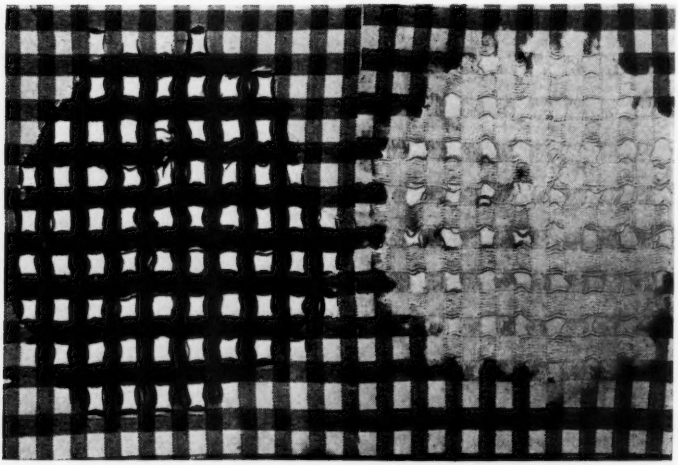


TABLE I. Percentages of Wool Found in 6 Different Fabrics Analysed by Caustic Boil, Aluminum Chloride, Sulphuric Acid and Flotation Methods. Figures Given Are, in Each Case, the Average of Three Samples Tested.

Fabric	Caustic Boil	$AlCl_3$	H_2SO_4	Flotation
A	78.4	78.2	79.5	79.2
B	20.3	21.2	21.3	20.5
C	63.0	62.9	63.9	62.6
D	30.3	31.4	31.9	30.0
E	12.5	12.9	14.1	12.3
F	—	32.4	28.0	32.3

fabrics. Fabric C contained ⅔ wool; D, ⅓ wool.

Fabrics E and F were blankets bought on the retail market. Fabric E was not labeled for fiber content. Fabric F was labeled 50 per cent staple rayon, 25 per

TABLE II. Percentages of Wool Present and Found in Wool-cotton and Wool-rayon Known Mixtures Analyzed by Caustic, Aluminum Chloride, Sulphuric Acid, and Flotation Methods.

	Wool-cotton Mixtures				Wool-rayon Mixtures			
	1	2	3	Mean	1	2	3	Mean
Caustic boil method								
Wool present, percent	48.7	49.4	49.5		49.1	49.7	49.6	
Wool found, percent	47.9	48.7	48.9		48.9	49.7	49.6	
Difference, percent	−0.8	−0.7	−0.6	−0.7	−0.2	0.0	0.0	−0.1
Percentage loss of cotton or rayon	1.5	1.6	1.7	1.6	4.6	4.9	4.9	4.8
$AlCl_3$ method								
Wool present, percent	47.6	47.3	47.3		50.5	49.4	50.1	
Wool found, percent	47.2	46.6	46.6		49.7	48.8	49.5	
Difference, percent	−0.4	−0.7	−0.7	−0.6	−0.8	−0.6	−0.6	−0.7
H_2SO_4 method								
Wool present, percent	47.6	48.3	48.8		49.7	49.7	50.3	
Wool found, percent	48.3	48.5	49.4		50.3	50.3	50.8	
Difference, percent	+0.7	+0.2	+0.6	+0.5	+0.6	+0.6	+0.5	+0.6
Flotation method								
Wool present, percent	50.6	50.2	49.8		50.1	50.8	51.4	
Wool found, percent	52.5	48.5	46.9		50.3	51.7	54.3	
Difference, percent	+1.9	−1.7	−2.9	−0.9	+0.2	+0.9	+2.9	+1.3

cent wool, and 25 per cent cotton. Both had been treated with a moth repellant. All-wool, all-cotton, and all-viscose rayon fabrics, also manufactured for experimental purposes were used in making up known mixtures.

Test Procedure

All fabrics were carefully degreased before sampling, four samples were cut from each of three blocks of fabric and assigned at random to the four methods.

The data in Table I indicate that the sulphuric acid method can be expected to give higher results than do the other methods. The reverse was true in fabric F; hence it seemed advisable to exclude the data for this fabric from all of the statistical calculations. The table shown gives the mean of three samples tested in each case.

Table II gives comparison of the wool actually present and found by test in known mixtures tested.

To summarize the conclusions drawn from the results, it would seem that the caustic boil is not only a useful method because of the rapidity and ease with which it can be carried out, but it is extremely reliable and can be very accurate if the correction factor can be accurately determined. Apparently further work needs to be done in order to determine whether the factors for cotton and rayon are constant for all fabrics; that is, whether the loss of cotton or rayon is dependent upon the type and quality of the fiber itself, or entirely upon the conditions of tests such as concentration of solution and length of time of boiling.

The flotation method is not reliable but might be useful in some instances, especially wherever it is desirable or necessary to use small samples, or to recover both fractions. The aluminum chloride would be an excellent method were it not for the inconvenient and time-consuming carbonization process. The sulphuric acid method probably offers the best possibilities for further improvements to increase accuracy. It does, however, require the use of quantities of 70 per cent sulphuric acid which may not always be available in the present emergency.

We Must Get in the Scrap

AN EDITORIAL

► The total capacity output of pig from our blast furnaces is approximately fifty five per cent of the total capacity requirement of our steel mills, to say nothing of the vast amount needed for iron castings. The difference has to be scrap—and then more scrapping.

► I submit that the time has come to get hard boiled and discard the idea of saving something for use in some dim distant after-the-war future. Every piece of obsolete equipment should be scrapped right now. Eventually every piece of equipment that is not needed in direct war effort or for essential civilian production must be thrown in, in an effort to fill the gap. Or else, with the enemy hammering at the gates, we will find ourselves "with the devil to pay and no pitch hot."

► Industrialists have organized the American Industries Salvage Committee in cooperation with WPB, and backed it with real money, to assist the WPB in its effort to secure the needed metal and other scrap material such as rope, rubber, rags, etc., in the hope that America will rise voluntarily to this critical emergency and obviate the necessity of a program of ruthless requisitioning—for this country is going to wake up and get tough before long.

► The time to act is now and if you do not already have a salvage committee in your own district you should write at once to Industrial Salvage Section, Conservation Division, WPB, Washington, D. C., for details of what to do, and then do it.

Julian S. Jacobs

Tests of Mixed Fabrics Indicate The Importance of Wool to

Warmth of Fabrics

There exists a controversy as to whether the use of wool below a certain percentage in mixed fabrics is justified from the standpoint of added warmth or wearing qualities.

In order to shed a little light on this subject the Manville Jenkes Corporation, Manville, R. I., had a series of warmth tests made by a leading testing company. The report of these tests, of which the following is an abstract, has been made by K. B. Cook, vice president of Manville Jenkes Corp. A more detailed coverage of this report appears in Textile World, September, 1942.

A SERIES OF TESTS were made by the guarded hot plate method both in still air and in moving air under suitable control in both cases of all conditions governing the tests, and of heating and cooling units, air flow, measuring devices, etc. In the tests in still air the warm side of the sample was maintained 93° F. while the outer side was exposed to a temperature of 43°. In the tests in moving air the warm side was maintained at the same temperature and the outer side exposed to a current of air under a velocity of 6 miles per hour with a constant temperature of 43° F.

Measurements were taken in terms of the heat passing through one square foot of sample surface area in British Thermal Units per hour for each Fahrenheit degree of temperature difference maintained on opposite sides of the specimen. For the purpose of interpretation this quantity was converted into a coefficient which is directly proportional to the heat retaining capability of the

TABLE I. Classification of Fabrics Tested.

Style	Weave	Wool %	Rayon %	Cotton %
A	Gabardine	100	0	0
B	"	68	0	32
C	"	20	50	30
D	"	8	62	30
E	Cavalry Twill	100	0	0
F	" "	70	0	30
G	" "	30	38	32
H	" "	20	48	32
I	" "	8	60	32

sample. The larger the coefficient for a single test condition, the warmer is the sample. The figures in Table II are in terms of the coefficients.

Tests were also made after samples had been submitted to a series of five dry cleanings in order to bring out the effects of differences in construction, composition, finishing, etc. Test data are shown in Table II.

Group No. 1 samples as indicated in Table I were of Gabardine weave and all of approximately the same weight and construction. Group No. 2 are of Cavalry

TABLE II. Warmth Coefficients.

Sample No	Original		After 5 Dry Cleanings		Change in Warmth Coefficient Due to Dry Cleaning	
	Test No. 1 Still Air	Test No. 2 6 M.P.H.	Test No. 1 Still Air	Test No. 2 6 M.P.H.	Test No. 1 Still Air	Test No. 2 6 M.P.H.
Group No. 1						
A	630	376	705	432	75	56
B	650	394	715	453	65	59
C	632	357	685	403	53	46
D	650	360	673	394	23	34
Group No. 2						
E	642	403	710	476	68	73
F	652	390	700	450	48	60
G	650	406	710	432	60	26
H	676	412	700	439	24	27
I	648	391	688	417	40	26

Twill weave and also approximately the same weight and construction. It will be noted that there is very little difference in warmth value between any of the original samples before dry cleaning. After the fabrics were submitted to five dry cleanings it is noted that all samples increased in warmth and some samples increased slightly more than others. The fact that shrinkage took place in all cases due to the dry cleaning treatments resulted in a more condensed fabric accounting for the increase in warmth. The dry cleaning solution used in these tests was the same as that used in a commercial dry cleaning house, although these Laboratory tests are a little more strenuous and the cleaning action is more thorough.

The tendency of wool to produce a lofty yarn and also to maintain its resiliency after being subjected to dry cleaning treatment accounts in part for the greater increase in warmth in the samples containing the larger percentage of wool. It is apparent, however, that all the samples listed in Table II even after dry cleaning possess approximate average warmth retaining qualities.

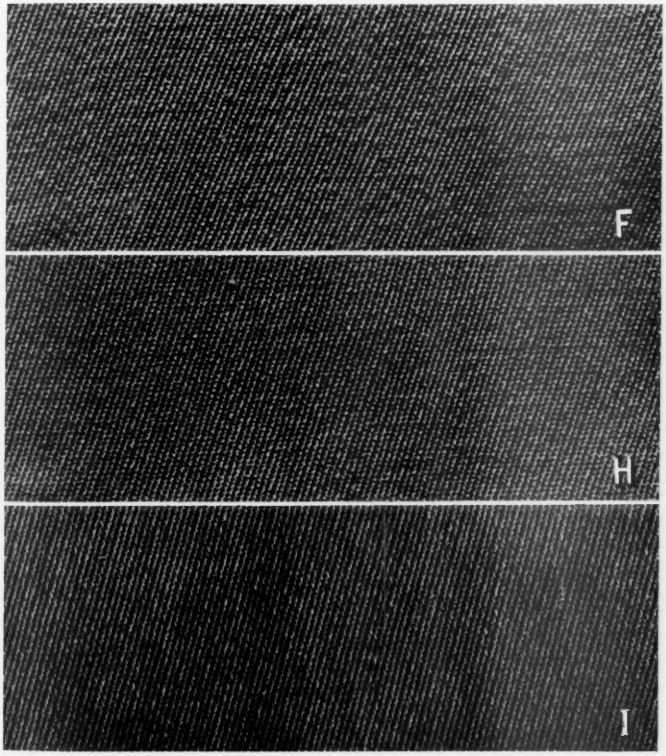
It is thus clear that the thermal transmission does not depend upon the kind of fiber in the fabric, but rather on the construction, thickness, etc. The structure of the fabric plays a considerable part when used in a curent of air. For instance, a current of air can sweep out some of the entrapped air in a fabric very much easier with some constructions than others. Thus a sweater may be a good insulator in still air but not in a wind.

In the August 1941, *Journal of the Textile Institute* there is an interesting article on the transmission of heat through textile fabrics, and the conclusions they reach are the same as found in this recently completed series of tests. The warmth of fabrics must not be confused with the "cold feel" of fabrics, which is an entirely different thing. This affect varies markedly in different fabrics and is an important feature as regards comfort in putting clothing on next to the skin. In this case the rougher or fuzzier the cloth is, the warmer it feels, and the smoother

and slicker a cloth is, the colder it feels. This is why linen sheets always feel so cool.

Abrasion tests indicate very little difference in wearing qualities between the piece made from 100 per cent wool and that containing 8 per cent wool. The piece containing 68 per cent wool shows practically double the wearing qualities due to the fact that this piece had been treated with a water repellant finish, while the other gabardine fabrics were not. With the Cavalry Twill fabrics, the pieces with lower wool content show better wearing qualities than those with higher wool content.

Samples of fabrics used in warmth tests



RESEARCH AIDS

Textile Fiber Atlas

A publication that has long been needed as a standard reference guide is the new Textile Fiber Atlas.* It presents for the first time a set of photomicrographs of the important textile fibers, natural, regenerated, and synthetic. These photomicrographs represent a careful selection of the best work in that field, and present clear cut illustrations of both external and internal structural details. It is excellent work and the authors are to be congratulated.

These photographic reproductions of fibers are arranged on plates with a separate section of pages of descriptive text which include details and tables of fiber measurements, a nomograph for direct comparison of the different systems of measurements. Also in the section on fiber damage, are given some details for fiber analysis.

This arrangement is by loose leaf system so that additions can be made as supplementary plates are issued. A comprehensive bibliography is included.

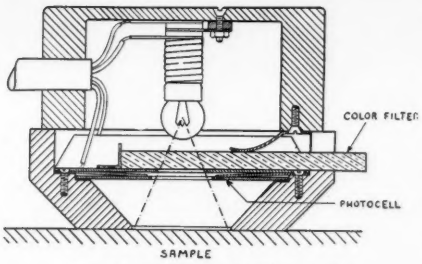
The authors are Werner Von Bergen, Director of Laboratories, Forstmann Woolen Co., and Walter Krouse, textile microscopist, technical laboratories, Sears Roebuck & Co.

* *Textile Fiber Atlas*, American Wool Handbook Co., 303 Fifth Ave., New York.

Photoelectric Reflection Meter

For measuring the brightness and color of fabrics and other surfaces, and for measuring the amount of fading or weathering, a new reflection meter has been developed.

The instrument is provided with a "search unit" which comprises the light source and the photocell. This search unit is placed on the fabric to be tested, making it unnecessary to insert the sample into the machine. The



Search unit of reflection meter

test specimens can, therefore, be of any size and may be tested in rapid succession. Since the surface to be measured remains exposed to the view of the operator, he can shift the search unit from one selected place to another, or he may move the search unit slowly across the surface to check the uniformity of color or brightness.

Three color filters are furnished with the instrument. By taking three readings in the parts of the spectrum isolated by the filters, colors can be specified and close color matching is made possible, independent of the judgment of an observer.

The instrument is built into a portable wooden casing with cover and carrying strap and can be furnished with built-in dry-cell batteries or for operation from the power line. It is rugged in design and easy to operate so that it can be used in the plant for production control purposes as well as for research in the laboratory.

The reflection meter can be had from Photovolt Corp., 95 Madison Ave., New York. Prices range from $105 to $175.

Reflection meter for testing colors

For Economic Security and Prosperity After the War, We Must Have

Postwar Full Employment

*An economic program for postwar prosperity and full employment involving a new outlook on economic problems is put forward by Alvin H. Hansen * of Harvard in a pamphlet published by the National Resources Planning Board, entitled "After the War—Full Employment." Prior to final printing, a pre-print edition of the pamphlet was circulated to members of the Federal Reserve Banks and to a group of businessmen, economists and labor leaders for comments and suggestions, as a result of which numerous revisions in the text were made.*

Whether one agrees or not with Dr. Hansen's conclusions, his ideas carry considerable weight in many parts of official Washington. We feel that our members should be kept informed on current thinking because of the influence it may have on the course of events. The following is a condensation of this study.

ALTHOUGH WINNING THE WAR is our immediate aim, another decade of economic frustration and mass unemployment may bring social disintegration and, sooner or later, another international conflagration. A positive program of postwar economic expansion and full employment, boldly conceived and vigorously pursued, is imperative.

Many people expect and fear a postwar collapse. Some hope for a postwar boom. We got the boom after the last war and may get it again. If the war lasts several years we may have at the end sufficient accumulated

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shortages in goods and equipment required to supply peacetime consumption demands to give us a vigorous private investment boom. Indeed, we need to be on the alert to prevent a possible postwar inflation. If we do have a boom, there is the gravest danger that it will find us unprepared for the collapse which will follow—unless we take appropriate action in time.

Everywhere one hears it said that, when this war is over, all countries, including our own, will be impoverished. This view is, however, not sustained by past experience. No country need be impoverished if its productive resources (both capital and human) are intact. The productive resources of this country will be on a higher plane when this war is over than ever before. A larger proportion of our population will be trained to perform skilled or semi-skilled jobs. We shall have enormous production capacities in all the machine industries. We shall have the equipment, labor, and natural resources to produce a higher real income for civilian needs than any ever achieved before in our history. Whether we shall attain that level of income will depend upon our intelligence and capacity for cooperative action.

Democratic Planning for Full Employment

We must make up our minds as a Nation that we will not permit a postwar depression to overwhelm us. We need not take economic defeat after the military victory is won. We can, if we will, maintain business prosperity. We can sustain continued demand for goods. We can keep industry and employment going at high levels.

We have every reason to expect the national income to rise to around 100 billions, in terms of 1940 dollars. If we let the income slide down too far we shall have a hard fight on our hands to bring it up again. We must deliberately set out to hold the new income level and to push it higher as rapidly as increasing productivity will permit.

We do not want the Government to run the whole show. We do not want a totalitarian state. We want

freedom of enterprise; for collective bargaining; for cooperative action; and freedom of choice of occupation.

If purchasing power is maintained at a high level, we need have no fears that private manufacturers, retailers, wholesalers, and farmers will not come forward and supply the market with the goods demanded by the public. Private business can and will do the job of production. It is the responsibility of Government to do its part to insure a sustained demand. We know from past experience that private enterprise has done this for limited periods only. The ever-increasing gigantic powers of production of the modern industrial system means that enormous output has to be reached before full employment is approached. Private industry and Government must act to maintain and increase output and income sufficiently to provide substantially full employment.

Need Governmental Program

When the war is over the Government cannot just disband the army, close down munition factories, stop building ships, and remove all economic controls. We want an orderly program of demobilization and reconstruction. The Government cannot escape responsibility for the great task of ensuring a vigorous expanding and prosperous society. This we all want, but—can private enterprise survive such a program? And how about taxes and the public debt?

A positive Governmental program looking toward full employment would greatly invigorate private enterprise. There is plenty of work to do. We need improved manufacturing equipment to produce more and better goods at lower prices. We need to carry on extensive research in the laboratories of our private corporations, in our universities, and in Government bureaus to create new products and develop new processes. We need to rehabilitate and modernize our transportation system—by land, water and air. We need to rebuild America: urban redevelopment projects, rural rehabilitation, low-cost housing, express highways, terminal facili-

ties, electrification, flood control, reforestation. Public developmental projects open fresh outlets for private investment. We need a public health program, including expansion of hospital facilities. We need to expand our education, cultural, and recreational facilities. We have seen how it is possible to mobilize the productive capacities of the country for war. We can also mobilize them for peace. Under a program of full employment new enterprises would grow up; old enterprises would expand.

We Can Finance Own Production

The notion that we cannot finance our own production is quite without foundation. Every cent expended, private and public, becomes income for members of our own society. Costs and income are just opposite sides of the same shield. We can afford as high a standard of living as we are able to produce; we cannot afford to waste our resources of men and material. The public expenditures required to maintain full employment can be provided out of the enormous income which the full utilization of our rich productive resources (material and human) makes possible. The costs of producing this income are merely payments to ourselves for the work done. There cannot be any financing problem which is not manageable under a full employment income. From a 100 billion dollar income we can raise large tax revenues, large enough to service any level of debt likely to be reached and to cover all other Government outlays, and still retain for private expenditures more than we had left in former years under a 70 billion dollar income with lower taxes. Taxes are merely one way of paying for social services and public improvement projects which we need. But it is not necessary or desirable under all circumstances to finance all public expenditures from taxes. Whether taxes should equal, fall short of, or exceed expenditures must be decided according to economic conditions.

It is often said that we must tighten our belts and pay off the Government debt when peace returns. But it is not desirable to pay off part of the debt when there is

danger of depression or when the effect would be to cause a drastic decline in the national income. Equally, it would be financially unsound to increase the public debt when there is a tendency toward an inflationary boom.

Assume that after the war tax money is available for repayment of the public debt. Some holders of bonds receiving the repayment may wish to spend the proceeds, but most will want to reinvest. If new private investments offer adequate opportunities to absorb these funds together with the amount normally saved from income, the process of debt retirement will operate in a quite satisfactory fashion. But if not, the Government has no recourse (if unemployment and a fall in national income are to be avoided) except to borrow the money back again and devote it to useful public projects.

About 75 per cent of the public debt is held by institutions (such as banks, insurance companies, etc.) performing useful and necessary services which require adequate income. Balanced against the interest charges on the debt are the interest receipts of institutions and individuals who own the bonds. Thus the public debt is no such burden on the community as is commonly supposed. It is rather a transfer of funds from one group to another.

Payments on Public Debt

The public debt is something very different from the private debt of an individual. An individual will always improve his asset position if he is able to pay off part of his debt. But a nation may make itself poor by repayment of the public debt. This is true because such repayment tends to cause deflation, depression, and unemployment. It is a good thing to pay off part of the debt if you want to check an excessive boom. It would be ruinous to pay off the public debt in a post-defense period when unemployment was spreading.

A public debt internally held has none of the essential earmarks of the private debt of an individual. A public debt is an instrument of public policy. It is a

means to control the magnitude of the national income and, in conjunction with the tax structure, to affect income distribution.

The Postwar Gap

In 1940 our national income was 76 billion dollars, of which 65 billions were spent on consumption, 8 billions on net capital formation (over and above replacement capital expenditures) and 3 billions on defense. In 1943 or 1944 our income in billions (1940 prices) may well be divided as follows:

Consumption	$55	billions	
Net capital formation	5	"	
War (incl. plant, equipment, lend-lease)	40	"	$100 billions

It is likely that consumption can be held down to the 55 billion dollars only by (1) heavy income and consumption taxes during the war effort; (2) part payment of the increased wage and salary bill in defense bonds (Keynes' plan); and (3) large voluntary purchases of defense bonds. If these ends can be achieved during the war period, the postwar release of funds thus diverted would help greatly to raise postwar consumption and so fill part of the gap from curtailment of war expenditures.

In the postwar period the problem is how to fill this gap. Let us suppose the following components of the postwar national income:

Consumption	$80	billions	
Net capital formation (including public works and housing)	10	"	
Defense (including International R.F.C.)	10	"	$100 billions

In the postwar transition the increase in consumption from 55 to 80 billion dollars might come from: (1) full cash payment of wages and salaries in lieu of assumed

partial payment in defense bonds; (2) sale of defense bonds and spending of receipts on products on which deficiencies have been accumulated; (3) expansion of consumer credit; (4) reduction of excise taxes; (5) shift of expenses from defense bonds to consumption; (6) enlarged program of Federal expenditures.

The potentialities for expansion of consumption and private investment in the immediate postwar period are sufficient to indicate the possibilities of a fairly prolonged boom. The Government should play a balancing role, checking any temporary tendency toward an excessive boom, and, on the other hand, prepared to go forward with large Federal expenditures on public improvement projects to compensate for any strong tendency toward inflation and depression.

In a highly fluctuating society, corporate profits are high in good times and extremely low in bad times. If, however, it were possible to maintain continuously a full-employment national income, it is obvious that corporate profits, representing the same percentage of national income as that averaged over the past cycle, would yield an absolute profit figure far above the average of 1925–40, though lower than in the boom years.

For the Postwar Period the Following is Suggested:

(1) Retention of graduated tax structure and broadened tax base, with major emphasis on the individual income tax and less reliance on the corporate income tax.
(2) Sharp reduction in defense consumption taxes.
(3) Adequate plans by private enterprise for investment projects in plant and equipment, railroads, public utilities, housing.
(4) Adequate program of public improvement projects.
(5) Expansion of public welfare expenditures.
(6) International collaboration to promote employment, develop backward countries, and to implement ways and means to open outlets for foreign investment, promote world trade and the effective world-wide use of productive resources.

RESEARCH BRIEFS

DETERMINATION OF COPPER IN TEXTILE MATERIALS TREATED TO PREVENT MILDEW, describes the successful adaptation of two methods for determination of the percentage of copper in fabrics which have been treated with copper containing compounds. Both of these methods gave accurate results in tests. Accurate methods are important today because of the necessity of meeting specifications for certain mildew-proofed fabrics. This article appears in *American Dyestuff Reporter,* August 17, 1942, p. 395–398.

THE PRESENT SITUATION IN RAMIE FIBER reviews briefly some of the properties of ramie, alludes to the Manawul process for degumming which is stated to have overcome the problem of producing a flexible fiber, and discusses with illustrations a number of fabrics made from ramie blended with wool, cotton or spun rayon. This article is by A. C. Whitford, Ph.D., and appears in *Rayon Textile Monthly,* August, 1942, p. 49 (459)–51 (461).

THE SOLUBILIZING ACTION OF AVAILABLE COMMERCIAL DETERGENTS UPON WATER INSOLUBLE DYES is treated in an article by J. W. McBain and R. C. Merrill, Jr., of Stamford University. The solubilizing power of these detergents is illustrated by measurements given of the solubility of Orange OT in solutions of the detergents. This report appears in *Ind. and Eng. Chem., Ind. Edition,* August, 1942, p. 915–919.

MILDEWPROOFING MILITARY FABRICS describes extensive experiments carried out at the laboratories of U. S. Testing Co. which indicate that a phenyl mercuric

acetate is effective as a mildewproofing agent for textiles. These experiments indicate 1, that fabrics treated with the compound meet or exceed U. S. Army specifications; 2, that there is a high degree of permanency from the treatment; 3, to the unaided vision there is no alteration of the feel, texture or nature of fabrics so treated; 4, the cost of treating fabrics with this compound is small, as very dilute solutions are used; 5, fabrics treated with the solution in proper dilution may be considered as non-toxic. Complete details regarding this compound and of the experiments are reported in an article by W. S. Marsh, bacteriologist and A. E. Duke, technical Assistant, U. S. Testing Co., and appears in *Textile World,* August, 1942, p. 58–60.

DETECTION OF SECOND-HAND WHITE COTTON FILLING MATERIALS used in articles of bedding and upholstered furniture is possible through chemical, fluorescent, and pH tests. Details are given in an article by C. M. Jephcott and W. H. H. Bishop, appearing in *Ind. and Eng. Chemistry, Analytical Edition,* July 1942, p. 400–404.

QUANTITATIVE DETERMINATION OF CELLULOSE IN RAW COTTON FIBER, describes a new and more simple method. This method which is very accurate, appears in an article by M. H. Neustadt of the U. S. Dept. of Agriculture in *Ind. and Eng. Chemistry, Analytical Edition,* July 1942, p. 432–434.

PRACTICAL METHODS FOR RECLAIMING ONCE-USED AGAR FOR RE-USE, recently developed by two Washington research workers, are described in *Science,* July 3, 1942.